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Preliminary Studies on the Efficacy of Honey in Milk Preservation

Aliyu Isa[1], Usman Hamidu[2], Ibrahim Musa[1], Abdulkadir B. Galadima[1]
[1]Department of Science Laboratory Technology, Ramat Polytechnic P.M.B 1070, Borno State – Nigeria
[2]Department of Agricultural Technology, Yobe state College of Agriculture Science & Technology

Abstract: *This work was aimed at analysing the effectiveness of honey to enhance the shelf life of milk sold in some part of Maiduguri. Milk are produce in several part of Borno state, but it could not withstand the test time due lack of proper storage facilities. Samples were collected from Maiduguri Monday market. During this analysis bacterial load and pH value i.e. acidity were used as parameters, test and control were analysed for four days at the temperature of 37^{o}C in triplicate and an average reading was taken. From the results obtained in both preserved and control samples, differences in both pH and microbial load were observed with increase in every increase in time. In day one 4 x 10^{3} colony forming unit (CFU) and 6.9 pH value were observed in both samples, similarly, in day two 5 x 10^{3} CFU and 6.8 pH value were observed while 7 x 10^{3} and pH value 6.5 were obtained in the control sample, in day three 7 x 10^{3} CFU and 6.7 pH value were obtained in the test sample while 9 x 10^{4} and 5.4 pH value were obtained in the control, in day four 9 x 10^{3} CFU and 6.5 pH value were obtained in the test sample while 7 x 10^{5} and 4.8 P^{H} value were obtained in the control sample respectively. At end of this work it is established that pure honey have little effect on the shelf life of the milk as slight changes is observed in both pH and bacterial load in milk with honey and the one that served as control. It was also observed that at pH range of 4.5 to 50 usually get spoiled in this case, At day 3 and 4, the milk has already shown sign of spoilage due odour and texture as indicated by low pH of 4.8 - 5.4 respectively.*

Keywords*: Honey, Milk, Spoilage, Bacterial load, pH, Colony forming unit (CFU)*

INTRODUCTION

Milk and its related products consist of major food products which it provides the sole source of nourishment with rich nutritive values, however, the rich supply of products such as proteins and vitamins in them make it a very good source of growth medium for several pathogenic and spoilage micro-organisms such as *Klebsiella*, *Bacillus*, *Pseudomonas* and *Staphylococcus* are some of the most commonly encountered. Not only in infant, milk serve as one of major in adult, large world population rely on milk as source of source of food and other vitamins such

as vitamins including vitamin A, riboflavin, pyridoxine, biotin, niacin, vitamin D etc. Research findings have revealed that other characteristics of milk also support bacteria growth, such as water availability and dissolved oxygen which supports both aerobic and facultative anaerobic microorganisms (Singh& Anderson, 2004).

Milk preservation is a major setback especially where refrigeration facilities are a limited or in places where the temperatures go beyond 30^{o}C (Assaf and Khatib, 2021). Maintenance of food products intend in maintaining value both physiochemical and functional properties during their shelf life could be achieved by potential natural preservative which is best and more harmless, it was suggested that antioxidant could be significant contributors in mediated bacteriostatic or bactericidal activity of honey which could be in turn serve as natural preservative for milk (Krushna *et. al, 2007)*. Use of bio-preservative such as whole organism or their products has more advantage as the issue of toxic effect is ruled out, non-immunogenic and enhance the safety of milk products (Ameer *et. al,* 2019). These bio-preservative in microorganisms are produced as bi-products in different forms (Hutcins *et. al,* 2001).

Usually, the pH of cow milk which is commonly used ranges between 6.4 to 6.8, this quality do change due to some conditions, one of such condition is the increase in bacterial population and hence increase in bacterial waste products as a result the pH of the milk changes and the milk become sour and more acidic. Moreover, this is obtained due to the ability of bacteria in the milk to converts the sugar lactose into lactic acid (Helmenstine, 2020). Acidity rises as milk got spoiled consequently, acidity can be quantified to measure milk quality. Which can be articulated in two major ways: titratable acidity,
and hydrogen ion concentration or pH, which indicates acid strength. The natural acidity of milk is 0.16% - 0.18%, and samples with higher figures indicate developed acidity (Ministry of Agriculture, 2013) At lesser pH levels of 4.0 - 5.0, lactic acid bacteria are capable of growth and can produce lactic acid, at the same time as these organisms inhibit the growth of many disease causing bacteria and are also intentionally engaged to ferment milk to create other dairy commodities such as yogurt and cheese, they can also induce undesirable spoilage in certain products (Lowe & Arendt, 2004, Ruiz-Argüeso & Rodriguez-Navarro 1973).

Sample Collection

The samples of milk and honey were purchased from Monday Market Maiduguri Borno State Nigeria in a sterile container and transported to the the lab aseptically.

Preparation of sample

The honey, garlic extract and samples was divided into working or test sample and control, the sample were made in triplicate, to the working sample 10ml of honey were added to 50ml of milk and mixed uniformly, the control was allowed without honey.

pH Determination

Water proof pH meter was employed, the pH electrodes were inserted into a clean water beaker containing calibration reagent and calibrated adequately.the sample to be tested were placed in a clean beaker containing each of the milk samples and the results were read from the monitor (Azeeza *et.al,* 2010).

Microbial Load Determination

The spread plate method was employed in determining the microbial load of the milk samples; ten fold serial dilutions of the sample were made. 1 ml was pippetted into a sterile Petri dish containing growth medium initially prepared and spread evenly, this was incubated at 37^0C for 24 hours. All colonies appeared on the plate were counted using colony counter and recorded approprately (Monica, 2006).

Similarly, odour and texture of the samples were observe every after 24hours

Table 1: Microbial Load of Test and Control

Period	Bacterial load (Test)	Bacteria Load (control)
Day 1	4×10^3	4×10^3
Day 2	5×10^3	7×10^3
Day 3	7×10^3	9×10^4
Day 4	9×10^3	7×10^5

Figure 1: Graphical Illustration of differences in microbial load between test and control samples

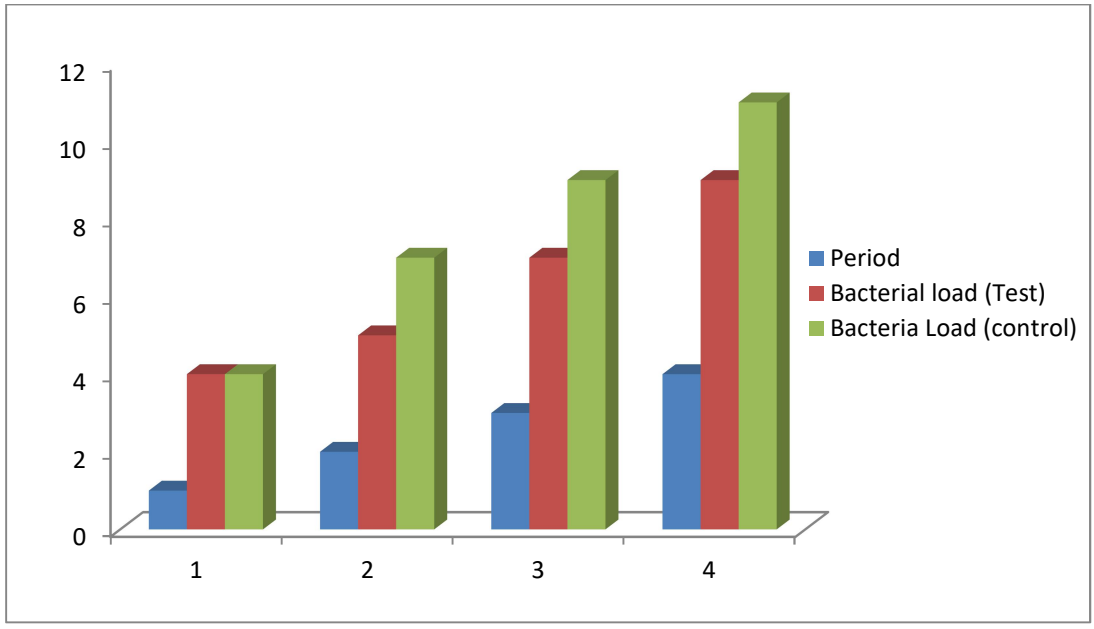
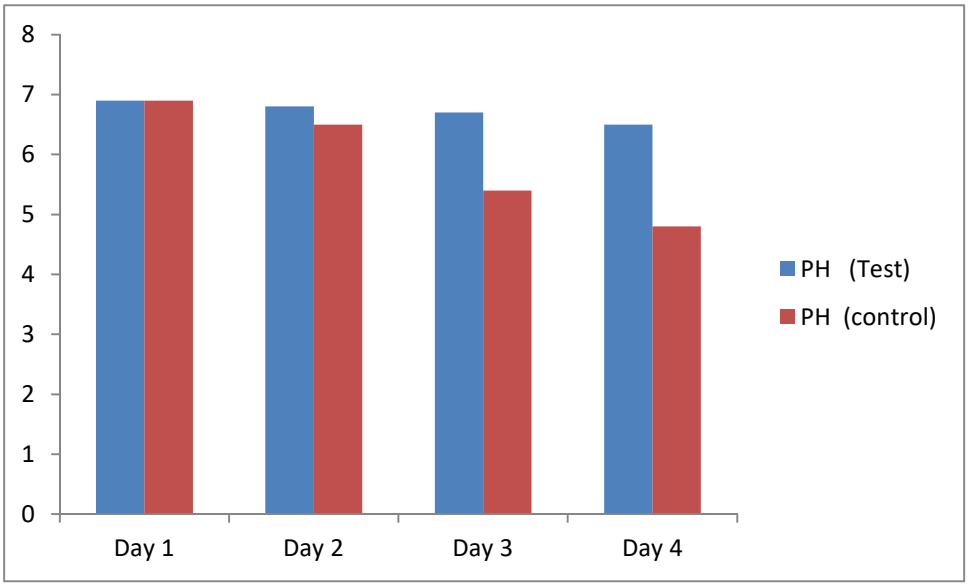


Table 2: pH Values of Test and Control

Period	pH (Test)	pH (control)
Day 1	6.9	6.9
Day 2	6.8	6.5
Day 3	6.7	5.4
Day 4	6.5	4.8

Figure 2: Graphical Illustration of differences in P^H between test and control samples



Discussion

From the result obtained in both preserved and control sample, differences in both pH and microbial load were observed with increase in every increase in time. In day one 4 x 10^3 colony forming unit (CFU) and 6.9 pH value were observed in both samples, similarly, in day two 5 x 10^3 CFU and 6.8 pH value were obtained in test while 7 x 10^3 and pH 6.5 were obtained in the control sample, in day three 7 x 10^3 CFU and 6.7 P^H value where obtained in the test sample while 9 x 10^4 and 5.4 pH value were obtained in the control, in day four 9 x 10^3 and 6.5 pH value where obtained in the test sample while 7 x 10^5 and 4.8 P^H value were obtained in the control sample respectively. It is observed that differences in microbial load and pH value (lower microbial load and low acidity value in test sample when compare to control) this shows that the honey is effectives to a certain extend in the preservation of the milk this is because microbial growths are reduced which in turn reduce acidity and this conforms with work of Aziza *et. al,* 2008. Similarly the microbial activity of the honey, its edible properties as well as its nutritional value combined together to make it a good and harmless preservatives.

As observed on the graph in figure 1, there is rapid increase in bacterial population in controlled sample more than the test sample, this is perhaps due to antibacterial activity of the honey which inhibits the growth of the bacteria and this assertion is in agreement with findings of Cooper *et. al,* (2002). The antibacterial properties in the honey serve as preservative in an indirect manner. Also, the graph in figure 2, which show the relationship between the pH of controlled and test samples, indicates an increase in acidity and in turn lower pH in controlled

and also lower acidity and more pH value in test sample, this is due to the decline in bacterial growth as also clearly stated by Helmenstine, (2020). According to Lowe & Arendt (2004), at pH range of 4.5 to 5.0 milk usually get spoiled.

In conclusion, at day 3 and 4, the milk in control has already shown sign of spoilage due odour and texture as indicated by low pH of 5.4 – 4.8 respectively however, the case is not the same in test sample as pH and microbial load is less and hence odour and texture are acceptable at similar day with controlled

Declaration of conflict of Interest

The authors declare that there is no conflict of interest whatsoever. The authors are responsible for the content and writing of the paper.

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